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RESEARCH PAPER

COMPARATIVE ASSESSMENT OF THE ECONOMIC RETURNS OF THE GROWTH OF *AMARANTHUS HYBRIDUS* USING ORGANIC (SUGARCANE BAGASSE BASED) AND INORGANIC FERTILIZER (NPK)

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ABSTRACT

Amaranthus hybridus is an important vegetable in the human diet because it is a source of nutrients such as vitamins, minerals, sugar, water, protein and fiber needed for healthy body growth and sustenance. Poor soil fertility, availability and affordability of inorganic fertilizer have been identified as major constraints to its production. These constraints may be addressed by the use of sugarcane bagasse based manure; hence the field trial to determine the Economic returns of the growth of *Amaranthus hybridus*. Data was collected on weight of the plant yield (kg), and the result subjected to Analysis of Variance (ANOVA). The field data was also subjected to Economic analysis using Gross Margin and Cost Benefit Ratio. The ANOVA result shows that Treatment A (Organic) had the mean yield of 3.30 (kg) which was significantly different from B (NPK) 2.21(kg) and C (Control) 1.47 (kg). Similarly, Treatment A had gross margin of 1500 and cost benefit ratio of 10.0; B had gross margin of 880 and cost benefit ratio of 4.4, whilst C had gross margin of 740 and cost benefit ratio of 7.4 respectively; suggesting that the use of sugarcane bagasse based fertilizer appeared more profitable and is recommended for maximum returns.

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Keywords: *Amaranthus hybridus*, gross margin, cost benefit ratio, Odi

INTRODUCTION

The ultimate goal of any production process is the output. Every farmer will want to minimize cost of production (input), so as to maximize profit (output). Any system of cropping that can increase the rate of crop yield and lower the cost of production will provide economic opportunity for farmers. To increase the availability of high quality Amaranth throughout the year at reduction in its price, there is a need to use organic manure (sugarcane bagasse based) since it maximize its growth and returns (Inyang *et al.*, 2018).

Vegetable growing is the most important branch of horticulture in view of the value of its products. About 89% of the total production of vegetables is taken in fresh stage while the remaining 11% are processed (Olujide and Oladele 2007). The increase in the number of people involved in vegetable production has necessitated the need for optimum production, in terms of input use to encourage vegetable production. Organic and inorganic fertilizer is a major input on sustainable vegetable production as the growth is stimulated in order to attain market value within a short period (Adeniyi *et al.*, 1992).

Amaranthus hybridus is usually a short-lived annual crop that grows up to 1m height; stem is erect, often thick and sometime grooved. The leaves are often green or purple, normally alternate petiolate and entire tip often obtuse. Laker

(2007) observed that of more than 100 different indigenous leafy vegetables species in Africa, Amaranth is the most widely consumed. *Amaranthus an* indigenous vegetable in Africa can become more popular with commercial growers if suitable high yielding variety, appropriate seed rate and organic and inorganic fertilizer is applied to promote the yield and nutritive value of *amaranth. Amaranthus hybridus* has short production cycle, high yielding and good nutritional value, and low cost of production. The crop can therefore support farmer income in Nigeria. Most of the important vegetables including *Amaranthus hybridus* have been identified as having potential for commercial exploitation and production for human consumption (Taylor and Moss, 1982). Aphane *et al*. (2003) observed that most indigenous plants are adapted to the prevailing conditions and require few agricultural inputs and perform well in areas unsuitable for vegetable production.

Amaranthus hybridus responds to soil with high organic content and adequate mineral reserve. This help to stimulate the plant growth in order to attain market value within a short period (Olujide *et al*., 2007). *Amaranthus hybridus* is grown during wet and dry season though; irrigation system or wetting device is normally required for dry season. The growth and yield increase are dependent on many factors ranging from water availability and distribution, spacing as well as nutrients supply, which is the major determinant of field addition or subtraction. *Amaranthus hybridus* grows rapidly and may be harvested 30-50days from sowing, when they are 15-20cm high.

Comparatively, organic manure outscores inorganic fertilizer in terms of having a wide range of essential nutrients. Inorganic manure is considered less efficient in supplying nutrients slowly to crops with time. It is therefore necessary to supplement for any nutrient that is known to be low in both compost and the soil, which is most limiting during crop growth and yield (John *et al*., 2017).

MATERIALS AND METHODS

Experimental site: A Field trail was carried out at Bioresources Development Centre Odi, Bayelsa State of Nigeria, during the 2017 early planting season, between February and March. The experiment adopted a Completely Randomized Block Design with three treatments and three replications. Treatment A Organic (sugarcane bagasse-based), Treatment B Inorganic (NPK) and Treatment C (Control).

Cultural practices: The experimental site was cleared, packed, tilled before preparing the seed beds. The beds measures 10m length and 50 cm widths. The seeds were raised in nursery for 3weeks and transplanted when the seeds were about 3-4cm in height. Weeds were controlled by hoe weeding at 3 and 5 weeks after transplanting and one plant was transplanted per hole. The yields (kg) of the plant were determined by measuring the total weight of the plant in each of the replicates.

Data Collection and Analysis: Random sampling of three (3) plants from each of the three treatments (replicates) — Treatment A (Organic), Treatment B (Inorganic) and Treatment C (Control) was done for data collection on the weight of the plant yield (kg) in each of the replicate and the result documented and subjected to Analysis of Variance (ANOVA), with significance differences observed in the result. Duncan Multiple Range Test was used to separate the means. The yield data was also subjected to economic analysis using Gross Margin and Cost Benefit Ratio. Gross Margin analysis is the difference between the total revenue and the total variable cost. That is:

Gross Margin (GM) = TR-TVC
Where:
TR = Total Revenue
TVC = Total Variable Cost

The Cost Benefit Ratio is also called the profitability index. It measures the amount of profit on any naira invested under the factors examined. It is expressed mathematically as:

Cost Benefit Ratio (CBR) = GM/VC
Where;
GM = Gross margin and
VC = Variable Cost of all factors examined.

Total variable cost represents the cost incurred on each treatment. This cost includes the cost of fertilizer (NPK), cost of organic manure (sugarcane bagasse based), cost of seeds etc.

The organic manure used for the experiment was prepared using sugarcane bagasse, poultry droppings and a well decomposed plant residues at a ratio of 3:2.5:1 respectively. The sugarcane bagasse was dried and carbonized. The fertilizer was further subjected to analysis and result shows that it contains nutrient elements that are very useful to the growth of *Amaranthus hybridus* plant.

RESULTS

Table 1: Analysis of the organic manure (Sugarcane bagasse based)

S/N	Parameter(s)	Value
1	Total dissolve solids, TDS (mg/kg)	331.6
2	pH	8.93
3	Conductivity (µs/cm)	603
4	Chloride (mg/kg)	85
5	Salinity (mg/kg)	140.2
6	Phosphate (mg/kg)	1.11
7	Nitrate (mg/kg)	2.6
8	Temperature (0^C)	26.9
9	Magnesium, Mg (mg/kg)	1,113.400
10	Calcium, Ca (mg/kg)	4,901.120
11	Iron, Fe (mg/kg)	3,058.240
12	Manganese, Mn (mg/kg)	158,440

Table 2: Analysis of Variance of the yield of *Amaranthus hybridus* grown with organic and inorganic fertilizer

Yield	Sum of Squares	df	Mean Square	F	Sig
Between groups	5.20	2	2.60	26.60S	.001
Within groups	0.59	6	0.09		
Total	5.79	8			

S = significant at 0.5%

Table 3: Mean separation table for the yield of *Amaranthus hybridus* grown with organic and inorganic fertilizer

Treatment	N	Mean Yield (kg)
Control	3	1.47[c]
NPK	3	2.21[b]
Organic fertilizer	3	3.30[a]

*Values within a column having different alphabet superscript are statistically significant ($p<0.05$) according to Duncan Multiple Range Test analysis

Table 4: Descriptive statistics for the yield of *Amaranthus hybridus* grown with organic and inorganic fertilizer

Treatment	N	Mean	Std. Deviation	Std. Error
Organic fertilizer	3	3.30	0.46	0.26
NPK	3	2.10	0.20	0.11
Control	3	1.47	0.21	0.12
Total	9	2.29	0.85	0.28

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Table 5: Cost of *Amaranthus hybridus* per treatment after sales

Treatment	Yield (kg)	Amount (₦)
Organic fertilizer	5.6	840.0
NPK	7.2	1080.0
Control	11.0	1650.0

Cost of *Amaranthus hybridus* per 1kg = ₦150

Table 6: Profitability analysis of *Amaranthus hybridus* grown with organic and inorganic fertilizer

Treatment	Yield (kg)	Revenue(₦)	TVC(₦)	Gross Margin(₦)	Cost benefit ratio
Organic fertilizer	5.6	840.0	100	720[b]	7.4
NPK	7.2	1080.0	200	880[b]	4.4
Control	11.0	1650.0	150	1500[a]	10.0

DISCUSSION

Any system of cropping that can increase the rate of crop yield and lower the cost of production will provide economic opportunity for farmers. The main objective of this work is to compare the economic returns of *Amaranthus hybridus* that was raised, using Organic and inorganic fertilizer. It was observed that significant yield was recorded per plot in treatment A (the sugarcane bagasse based treatment), followed by treatment B (the inorganic treatment). The treatment C (control) has the lowest yield per plot; this is because no nutrient was added to boost the growth of the plant.

The result of the Duncan Multiple Range Test between the three treatments at 0.05% probability level shows that yield of *Amaranthus hybridus* in the sugarcane bagasse-based treatment was significantly higher than other treatment as shown in Table 3 where treatments A, B and C had mean yield of 3.30, 2.10 and 1.47 respectively. Therefore, it can be deduced that organic manure positively influences the yield of *Amaranthus hybridus*, as also reported by Adebayo and Akoun, (2000).

Furthermore, the cost of production of *Amaranthus hybridus* using organic fertilizer has been categorized into two –the fixed cost and the variable cost. Fixed costs are costs that do not change as production volume increases within a relevant range. These costs include land, equipment used in carbonizing and blending the organic fertilizer etc. Variable costs are cost that varies in relation to either production volume or services provided. In other words, they are costs that vary depending on the volume of activity. These costs include; cost of fertilizer, labor, seeds etc. Treatment B (NPK treatment) gave the total highest variable cost of ₦200 with gross margin of ₦880, this is closely followed by treatment A (Organic treatment), with total variable cost of ₦150 and higher gross margin of ₦1500. Treatment C (Control) has the lowest variable cost (#0.00) of production but the yield and gross margin is relatively low due to the lack of organic and inorganic fertilizer in the treatment to boost the growth of the plant. It was also observed that the different fertilizer (organic and inorganic) applied had significant effect on the output of the *Amaranth*, even though treatment A (sugarcane bagasse-based) gave the highest yield and gross margin. The vegetable was sold at the same price per kilogram.

All treatment had the same number of population, but significance differences were observed in yield and revenue of the three treatments. The average revenue of treatment A, B and C were ₦1650, ₦1080 and ₦840 respectively, this implies that the availability of nutrient to each treatment differs in quality and quantity. This furthers agrees with Olujide and Oladele (2007).

CONCLUSION

It is concluded that the use of organic fertilizer (sugarcane bagasse-based) in Amaranth production leads to greater yield compared to use of inorganic fertilizers and should be encouraged amongst vegetable (*Amaranthus)* farmers.

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AUTHORS CONTRIBUTIONS

Inyang, J.O., Njoku-Onu, K.A., Oise, E.A., Augustin, E.U., Odoronam, J.F. and Sokare, I.D. were all involved at various stages of this research.